HABITAT PROFILE

Peatlands

Associated Species: Ringed Bog Haunter (Williamsonia lintneri), Palm Warbler (Dendroica palmarum), Mink Frog (Rana septentrionalis), Northern Bog Lemming (Synaptomys borealis)

Global Rank: Not ranked
State Rank: Atlantic white cedar – giant rhododendron swamp (S1), Atlantic white cedar – leather-leaf swamp (S1), Acidic northern white cedar swamp (S1), Atlantic white cedar – yellow birch – pepperbush swamp (S2), Black gum – red maple basin swamp (S1S2), Black spruce – larch swamp (S3), Bog rosemary – sweet gale – sedge fen (S3), Calcareous sedge – moss fen (S2), Circumneutral – calcareous flark (S1), Hairy-fruited sedge – sweet gale fen (S3), Highbush blueberry – sweet gale – meadowsweet shrub thicket (S4), Highbush blueberry – mountain holly wooded fen (S3S4), Highbush blueberry – winterberry shrub thicket (S4), Inland Atlantic white cedar swamp (S1), Large cranberry – short sedge moss lawn (S3), Leather-leaf – black spruce bog (S3), Leather-leaf – sheep laurel dwarf shrub bog (S1S3), Liverwort/horned bladderwort mud-bottom (S3), Marshy moat (S4), Montane alder – heath shrub thicket (S1?), Montane heath woodland (S2), Montane sloping fen (S1), Northern white cedar – balsam fir swamp (S2), Northern white cedar circumneutral string (S1), Northern white cedar – hemlock swamp (S2), Northern white cedar seepage forest (S2), Pitch pine – heath swamp (S1S2), Red maple – Sphagnum basin swamp (S4), Red spruce swamp (S3), Seasonally flooded Atlantic white cedar swamp (S2), Speckled alder wooded fen (S3S4), Sphagnum rubellum – small cranberry moss carpet (S3), Subalpine sliding fen (S1), Swamp white oak basin swamp (S1), Sweet gale – meadowsweet – tussock sedge fen (S4), Sweet pepperbush wooded fen (S2), Wet alpine/subalpine bog (S1), Winterberry – cinnamon fern wooded fen (S4), Wooded subalpine bog/heath snowbank (S1S2)
Federal Listing: Not listed
State Listing: Not listed
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Element 1: Distribution and Habitat

Habitat Description

The peatland habitat described here includes 11 different natural communities as described by Sperduto (2004). Peatlands are defined by limited inputs of groundwater and surface runoff that result in low nutrient content and acidic water. A lack of nutrients causes slower decomposition of organic materials, resulting in the accumulation of peat. Some plant species are specifically adapted to low-nutrient, acidic conditions found in peatlands.

Open Peatlands
Open peatlands are dominated by *Sphagnum* mosses, sedges, and shrubs. Several open peatland systems are found in New Hampshire. Alpine/subalpine bogs and montane sloping fens are found at higher elevations, generally above 760 meters (2500 feet). Alpine bilberry (*Vaccinium uliginosum*) and black crowberry (*Empetrum nigrum*) are dominant plants in alpine/subalpine bogs, whereas sedges are dominant plants in montane sloping fens (Sperduto and Nichols 2004). These peatlands are small and can sometimes be found interspersed with dry subalpine heath/krummholtz systems or at the heads of old beaver drainages.

Calcareous sloping fens and patterned fens are two open peatland systems found in northern New Hampshire. Calcareous sloping fens are influenced by groundwater seepage from bedrock high in calcium and other base cations. The diverse plant communities of calcareous fens include sedges, brown mosses, willow (*Salix* sp.) and dogwoods (*Cornus* sp.) (Sperduto 2004). Patterned fens are more common in northern regions and only three examples are known in New Hampshire. Also influenced by groundwater, patterned fens form a series of strings (linear, raised areas) and flarks (low, wet areas) that run perpendicular to the direction of groundwater flow. Strings have a typical bog species such as leather-leaf (*Chamaedaphne calyculata*), sheep laurel (*Kalmia angustifolia*), stunted black spruce (*Picea mariana*), and eastern larch (*Larix laricina*). Flarks have open pools and *Sphagnum* carpets (Sperduto and Nichols 2004). Poor level fen/bog systems and medium level fen systems are widespread and can be quite expansive. Poor level fen/bog systems have very little drainage and no input from groundwater, lakes or streams. Medium level fens can have stream and groundwater input, and therefore tend to be less acidic and more nutrient-rich than poor level fens/bogs. These two systems can often be found adjacent to each other. Vegetation in each includes open *Sphagnum*, tall or medium shrubs, and sparse black spruce (*Picea mariana*) or eastern larch (*Larix laricina*) (Sperduto 2004).

The kettlehole bog is an open peatland usually found in central and southern New Hampshire. These bogs are small patches where pieces of glacial ice melted, leaving holes that subsequently filled in from the edges with peat. Kettlehole bogs typically have a marshy border surrounding a tall shrub or black spruce (*Picea mariana*) swamp, within which is a boggy area of black spruce and leather-leaf (*Chamaedaphne calyculata*), and often an open *Sphagnum* carpet, sometimes with a pool of water, in the middle (Sperduto 2004).

Forested Peatlands

Several forested peatland systems are found in New Hampshire. The black spruce peat swamp is dominated by black spruce (*Picea mariana*) and eastern larch (*Larix laricina*). It often forms a border around more open peatlands such as the poor level fen/bog system or kettlehole bog system. Temperate peat swamps, found in central and southern New Hampshire, are dominated by red maple (*Acer rubrum*), red spruce (*Picea rubens*), eastern hemlock (*Tsuga canadensis*), and other hardwoods. This system is not as acidic as many other peatlands. Northern white cedar minerotrophic swamps, found in northern New Hampshire, contain more nutrients than other peatlands and are dominated by northern white cedar (*Thuja occidentalis*) and other conifers including balsam fir (*Abies balsamea*) and various spruces (*Picea* spp.). Coastal conifer peat swamps—dominated by Atlantic white cedar—are located in coastal New Hampshire with a few examples farther inland (Sperduto 2004).

1.2 Justification

Conservation of peatlands is vital to the continued existence of many rare species in New Hampshire. Changes in nutrients, water quality, or hydrologic inputs to peatlands can convert them to non-peatland wetlands that may not be suitable for original flora and fauna. Southern New Hampshire peatlands are susceptible to development, while northern peatlands require protection from potentially damaging forestry practices.

Peatlands play a vital role in carbon and nitrogen cycling (Moore 2002). However, peatlands across the globe may be at risk due to climate change, which may push these communities further north. The current range of many peatland communities barely extend southward into northern New Hampshire, making them, and the wildlife that depend on them, particularly vulnerable in this state.

1.3 Protection and Regulatory Status

Federal

Clean Water Act Sections 401 (USEPA 2005a), 402 (USEPA 2005b), 404 (USEPA 2005c): Requires a permit for discharge of pollutants, dredge, or fill material into navigable waters, such that the discharge will comply with water quality standards.

State

RSA 482-A, Fill and Dredge in Wetlands (New Hampshire General Court 2004): Requires a permit for any project involving dredge or fill impacts to wetlands.

Wt 303.02, Wetlands Bureau rules (NHDES 2004): Projects involving bogs, designated Prime Wetlands, rare or exemplary natural communities in wetlands, or endangered or threatened wildlife in wetlands are considered major impact projects.

RSA 485-A, Water Pollution and Waste Disposal (New Hampshire General Court 2004): subsurface wastewater disposal systems must be greater than 15 m from poorly drained (hydric B) soils and 23 m from very poorly drained (hydric A) soils.

RSA 217-A, Native Plant Protection Act (New Hampshire General Court 2004): Removing threatened, endangered or special concern plants from public land or land owned by another party is prohibited.

1.4 Population and Habitat Distribution

Peatlands are broadly distributed throughout the northeastern United States and Canada. However, many peatland types have a restricted distribution. New Hampshire is in a transition zone where peatlands typical of southern regions and northern boreal regions can be found. Medium level fens and poor level fens and bogs are widespread in New Hampshire. Kettlehole bogs and coastal conifer peat swamps reach their northern extent in southern and central New Hampshire. Patterned fens and calcareous sloping fens are restricted to northern New Hampshire, and alpine/subalpine bogs and montane sloping fens are restricted to high elevations of the White Mountains and northern New Hampshire. Peatlands are sparse in mountainous regions.

Many rare peatland plants are restricted to the northern or southern part of the state, or to higher elevations. Likewise, several wildlife species such as the ringed boghaunter, rusty blackbird (*Euphagus carolinus*), and northern bog lemming are restricted to only those peatlands in either the northern or southern part of the state. Several peatland Odonata and Lepidoptera reach their range limit in adjacent states or the province of Quebec but have not yet been found in New Hampshire (Herrmann et al. 2003, Paul Brunelle, personal communication), or have historic ranges extending into New Hampshire but have not recently been found (i.e., Hessel's hairstreak, *Callophrys hesseli*) (NatureServe 2005).

1.5 Town Distribution Map

See attached.

1.6 Habitat Map

Potential peatlands were mapped beginning with the National Wetlands Inventory (NWI) GIS layer (Complex Systems Research Center 2001). Wetlands with broad-leaf evergreen (generally ericaceous), needle-leaf evergreen (conifer) or needle-leaf deciduous (larch) vegetation were selected initially. Water regimes were restricted based on expert review (Dan Sperduto, NHNHB). Any groups of wetlands adjacent to a river or lake were omitted. NWI classes were further classed as individual peatland systems, and landscape context (i.e., elevation, isolation from other wetlands, presence of inlets and outlets) was used to assign each polygon to a potential peatland system. Polygons of known rare or exemplary peatlands (NHNHB 2005) were then added to the map.

Limitations of Data

The model was designed to be inclusive. NWI maps can underpredict peatlands (Dan Sperduto, NHNHB, personal communication). To counter this tendency to underpredict, other non-peatland NWI classes adjacent to peatland classes were included. Combined with the inclusion of many coniferous and deciduous wetlands (as black spruce peat swamp and temperate peat swamp systems), this may have led to overprediction. Because many coniferous or deciduous forested wetlands in southern New Hampshire (Gulf of Maine Coastal Plain and Gulf of Maine Coastal Lowland ecoregion subsections) could be eastern hemlock (*Tsuga canadensis*) or red maple (*Acer rubrum*) swamps without a peatland component, it is likely that many of the predicted forested peatlands are not actually peatlands. Any interpretations or actions based on the map should consider this overprediction. Classification of wetlands into specific systems could also contain error based on the general nature of NWI categories and the lack of more detailed information to aid in the classification.

1.7 Sources of Information

Information was gathered from literature review, GIS data, NHNHB data (2005), and expert review.

1.8 Extent and Quality of Data

Peatlands have been surveyed more extensively in New Hampshire than have many other natural community groups. An extensive landscape analysis and field inventory of peatlands was conducted in 2000

(Sperduto et al. 2000). See limitations of predicted peatlands in element 1.5 above.

1.9 Distribution Research

Surveys should be conducted for peatland species that are found in adjacent states and provinces, and to confirm and update New Hampshire's rare species records. Targeted species could include northern bog lemming, Hessel's hairstreak, bog elfin (*Callophrys lanoraieensis*), and a number of peatland odonates. Habitat records need to be field-verified, especially forested peatlands in southern New Hampshire and rare peatland communities in northern New Hampshire.

Element 2: Species/Habitat Condition

2.1 Scale

Wetlands within 250 m of each other were grouped into complexes of wetlands, except that wetlands separated by a major road (interstate, US or state route) were assigned to different complexes. Wetland complexes numbered in the thousands, and so rather than identify or analyze each complex individually, they were summarized statewide and by ecoregion (TNC 1998).

2.2 Relative Health of Populations

There are 4,113 ha of peatlands known in New Hampshire, and 18,996 ha of predicted peatlands. Total peatland area is less than 1% of New Hampshire's total land area. The majority of known peatland area falls within 5 ecoregions (Figure 1): the two coastal ecoregions, the two northernmost ecoregions, and one central ecoregion (Sebago-Ossipee Hills and Plain). Predicted peatlands generally follow the same pattern of distribution (Figure 1), except that a sixth ecoregion (Hillsboro Inland Hills and Plain) was also predicted to have a large peatland area.

Of the known peatland in New Hampshire, approximately 57% is open peatland and 43% is forested peatland. Forested peatlands are most common in coastal areas and northern New Hampshire. For example, 85% of the peatlands in the Connecticut Lakes subsection are forested. Elsewhere in the state, open peatlands are more abundant. It should be noted, however, that known peatlands are those that include rare or exemplary peatland communities and may not reflect the true distribution of peatlands across the state. At least 75% of the total predicted peatland area was forested (Figure 1). This is likely an overestimate (see element 1.6); however, because forested peatlands may be less obvious on the ground than open peatlands, these areas should all be considered potential peatlands until field verification shows otherwise.

2.3 Population Management Status

N/A

2.4 Relative Quality of Habitat Patches

The largest peatland complexes occurred in the Connecticut Lakes, Mahoosuc-Rangeley Lakes, and Gulf of Maine Coastal Lowland ecoregion subsections (however, note the potential for overprediction of peatlands in southern New Hampshire discussed in element 1.5). Within each ecoregion, an average of at least 75% of the area within a 250m radius of the complexes was undisturbed landscape (forest, wetland, or open water) . Twenty percent of all peatland complexes were surrounded by undisturbed landscape. However, the majority (62%) of these undisturbed complexes were small (less than 1 ha). Peatlands in northern New Hampshire averaged lower densities of roads within 250 m than did peatlands in the southern part of the state, with coastal peatlands having more than 1 km of road per km^2 of land area.

2.5 Habitat Patch Protection Status

Protection status was calculated for all the land area within 250m of each peatland complex, and summarized by ecoregion subsection (figure 2) using the Conservation Lands data layer (Complex Systems Research Center 2005). Total peatland buffer conservation land in fee ownership throughout the state was 34,605 ha, while total peatland buffer conservation land in easements was 8,896 ha. With the exception of the Northern Connecticut River Valley ecoregion, fee ownership conservation area was greater than easement conservation area throughout the state.

The highest level of protection is in the White Mountains, where 72% of total peatland buffer area is protected. In other ecoregion subsections, protection was less than 30% of peatland buffer area (figure 2). Within the White Mountains subsection, 62% of peatland complexes were entirely protected within 250m of the peatland, and 72% of complexes had at least 50% protection. However, this subsection had the smallest total peatland area of all subsections. The second highest level of protection was in the Connecticut Lakes ecoregion subsection, where only 23% of complexes had at least 50% protection. The two ecoregion subsections with the highest predicted peatland area—the Gulf of Maine Coastal Lowlands and Gulf of Maine Coastal Plain—also had the lowest level of protection, with less than 1% of complexes having at least 50% protection.

2.6 Habitat Management Status

Habitat management of peatlands is generally limited to land protection (see element 1.3). Restoration of peatlands is difficult and more commonly practiced in areas where peat is frequently mined or where forestry activities regularly occur on peatlands. These activities are not known to occur in New Hampshire at a large scale. Consequently, there is little active management of peatlands and there are few management strategies more effective than simply protecting land and allowing natural processes to occur. Several peatlands occur on lands managed for wildlife (i.e., Umbagog National Wildlife Refuge) where the primary management goals are for other habitats or wildlife and may involve water level management that is not conducive to peatlands. These areas may provide opportunities to study whether current management strategies could be improved for peatland habitats.

2.7 Sources of Information

Information was gathered from databases, GIS analysis, and expert review.

2.8 Extent and Quality of Data

The GIS data used to assess habitat condition are relatively detailed, coming primarily from satellite imagery, topographic maps, and well-defined conservation boundaries. The primary errors in assessing condition are in the predicted habitat itself, which depends partly on NWI maps, which can lead to errors in wetland classification.

2.9 Condition Assessment Research

- Aerial photo analysis and field surveys of predicted peatlands (particularly in the 2 southeastern and 2 northern subsections) to facilitate better boundaries and landscape analyses
- Evaluate effects of current wildlife management strategies (i.e., those focused on waterfowl or fish) on peatlands in wildlife management areas and national wildlife refuges

Element 3: Species and Habitat Threat Assessment

3.1.1 Development (Fragmentation, Habitat Loss and Conversion)

(A) Exposure Pathway
Construction near peatlands, which may involve dredging and filling, reduces available habitat for peatland-dependent species. Wildlife using peatlands, such as turtles, may also use uplands for part of their life cycle or for migration. Species that are restricted to peatlands may require connectivity between patches for occasional genetic exchange and maintenance of genetic diversity. Loss of upland habitat isolates peatlands and makes travel between them difficult for wildlife. Thus, fragmentation results in a loss of both genetic exchange and functional upland habitat.

(B) Evidence
In 2004, NHNHB reviewed 655 proposals requiring a permit for impacts to wetlands (NHNHB, unpublished data). Although projects with impacts to "bogs" are considered major impact projects in New Hampshire (NHDES 2004) and thus are reviewed more critically, some forested peatlands may not be recognized as such. Peatlands take a long time to develop due to the slow accumulation of peat; thus, lost peatlands are not easily restored (Rochefort et al. 2003). Peatlands can only develop within certain topographic and hydrologic settings (Crum 2000, Damman and French 1987), so artificial creation of

new peatlands is generally not possible.

Habitat fragmentation can influence many species including those with limited mobility (Mader 1984, Reh and Seitz 1990, Herrmann et al. 2005). Peatland and other wetland taxa are more likely to disperse through forested uplands than non-forested uplands (deMaynadier and Hunter 1999, Nekola et al. 2002), so habitat fragmentation could alter the upland to the extent that individuals are no longer able to migrate. Peatlands and other wetlands are patchy habitats within an upland landscape, and the wildlife that depend on them often exhibit little migration between patches (Gibbs 2000). With this limited migration and limited genetic exchange, any further hindrance to migration between habitats could render local populations vulnerable to extinction.

3.1.2 Altered Hydrology

(A) Exposure Pathway
Impoundments downstream from peatlands can raise the peatland water level to the point that nutrients previously transported past the peatland, via groundwater or a stream channel, are now in contact with the peatland. This increase in nutrients can alter the plant communities and the rate of peat decomposition. With more decomposition, the peat structure will change, affecting the topography of the peatland surface. The resulting wetland may no longer be suitable for peatland-dependent plants and animals.

(B) Evidence
Peatlands typically develop in places where the vegetation is not (or is minimally) in contact with groundwater or upland runoff (Damman and French 1987). As a result, they are very nutrient-poor compared to other wetlands and decomposition occurs at a very slow rate. Peat is the partially decomposed vegetative matter that accumulates beneath the surface vegetation and further separates plants from the underlying groundwater. In some cases, peatlands lie on either side of a deep-cut stream channel through which nutrient-carrying water flows and bypasses the peatland. Downstream impoundments may raise the water level and cause water that had previously bypassed the peatland to flow across the peatland surface, bringing more nutrients into contact with the vegetation and peat (Dan Sperduto, NHNHB, personal communication). Peat decomposes quickly under higher nutrient conditions (Aerts et al. 2001), and non-peatland vegetation will begin to grow under these conditions. Several non-peatland natural communities in New Hampshire are documented to occur on former peatlands that have been flooded by beavers (Sperduto and Nichols 2004).

3.1.3 Non-Point Source Pollution (Nutrients (Eutrophication))

(A) Exposure Pathway
Increased nutrient input through runoff, decaying woody debris, or hydrologic alterations changes the nutrient content of the water in peatlands. This increases the rate of peat decomposition, which in turn affects water transport through the peat and nutrient availability. All of these factors contribute to changes in the structure of the peat surface and the composition of the plant community. Generally, increases in nutrient levels change the peatland to a non-peat wetland that may not be suitable for peatland plants and animals.

(B) Evidence
Peatlands are nutrient poor systems where organic decomposition is very slow and organic matter (peat) accumulates over time. Peat accumulates as long as the rate of plant growth exceeds the rate of decay (Johnson 1985, Damman and French 1987). Peatlands are inhabited by a suite of plants adapted to nutrient-poor conditions (Sperduto and Nichols 2004). Increases in nutrient concentrations will change the plant community and the rate of organic decomposition (Aerts et al. 2001), resulting in a loss of peatland habitat. Land conversion and other human activities near peatlands can alter natural nutrient regimes through the combined effects of erosion, runoff, fertilizers, or hydrologic alteration. The rate of land conversion in New Hampshire, particularly in the two southeastern ecoregions, is quite high (NHNHB, unpublished data).

3.1.4 Unsustainable Harvest (Forestry Operations and Management)

(A) Exposure Pathway
Timber harvesting in forested peatlands changes the vegetation structure and the amount of decaying

woody debris in the peatland. It can also increase compaction of the peat and nearby soil, leading to increased runoff and nutrient inputs. In addition, forestry activities too close to peatlands could disturb peatland wildlife, leading to decreased nesting success of birds and other changes to wildlife populations.

(B) Evidence
In New Hampshire, any activity that involves dredging material from or adding material to a wetland requires a permit (NHDES 2004). However, forestry activities can occur in peatlands under frozen conditions, since neither dredge nor fill occurs under such circumstances. Forested wetlands are not always properly delineated, particularly on NWI maps (Dan Sperduto, NHNHB, personal communication), so attempts to avoid wetlands during timber harvesting may not be successful. Although peatland species such as black spruce, northern white cedar, and eastern larch are harvested in much lower volumes than are most other species in New Hampshire (Frieswyk and Widmann 2000), harvesting may still occur, particularly near the edges of peatlands. Forestry activities can also compact soil, particularly organic soils such as peat (New Hampshire Forest Sustainablility Standards Work Team 1997), leading to increased runoff. Decomposition of slash left near the edge of a peatland can alter the structure and density, and thus the water transport abilities, of the peat (Damman and French 1987).

3.1.5 Recreation (Off Road Vehicles)

(A) Exposure Pathway
The use of off-road vehicles in peatlands could cause severe destruction of vegetation and peat, and possibly erosion and channelization that would alter the flow of water and nutrients through the peatland.

(B) Evidence
Off-road vehicle use is increasing rapidly in the Northeast. The total number of registered off-road vehicles is predicted to reach 37,000 by the year 2008, an increase of 42% (New Hampshire Trails Bureau 2003). Unregulated, these vehicles can have devastating impacts on ecosystems (Taylor no date). Even though it is illegal to ride off-road-vehicles in any wetland in New Hampshire (NHFG 2005), individuals may leave trails and ride in peatlands or other wetlands if a trail passes within sight of one.

3.2 Sources of Information

Information was gathered from literature review, expert consultation, and databases.

3.3 Extent and Quality of Data

- There is a wide body of research on the ecology, hydrology, nutrient processes, and restoration of peatlands in northern Europe and Canada. Less research has been conducted in the northeastern United States, where peatlands are less abundant. The rarity of many peatland types in New Hampshire is well documented.
- The effects of habitat fragmentation on wetland-dependent wildlife have also been widely studied, but not as much research has been done on peatland-specific taxa. However, the high rate of human development and fragmentation in New Hampshire is well documented.
- The effects of forestry on soils, wetlands, hydrology, and nutrient dynamics are fairly well known for other regions, but this information is not as well known for New Hampshire peatlands.
- There is a good body of research indicating the severe impacts of off-road vehicles on ecosystems. There is also substantial anecdotal evidence (through newspaper articles) of off-road vehicle users violating laws and regulations. Thus, concern that New Hampshire off-road vehicle users may be violating wetland regulations is justified.

3.4 Threat Assessment Research

- Assess the level of timber harvesting in peatlands occurring during the winter. Assess the influence of forestry on coarse woody debris, soil compaction, nutrient cycles, and peatland habitat structure at various distances from peatland borders.
- Monitor use of off-road vehicle trails near wetlands to determine to what extent users are leaving trails and riding in wetlands. Monitor erosion, sediment, and nutrient inputs in peatlands near off-road vehicle trails.

Element 4: Conservation Actions

4.1.1 Conservation Action: Establish buffers around peatlands

Category: Regulation

(A) List of Direct Threats Affected
Development (Fragmentation, Habitat Loss and Conversion), Non-Point Source Pollution (Nutrients (Eutrophication)), Recreation (Off Road Vehicles), Unsustainable Harvest (Forestry Operations and Management)

(B) Justification

- Creating buffers will prevent some of the upland fragmentation surrounding peatlands, and will protect peatlands from increased nutrient input from forestry activities, erosion through off-road vehicles, or other land uses, through allowing surface water to infiltrate the ground rather than running directly into the peatland.
- Reducing these threats will facilitate maintenance of the water chemistry levels needed by peatland plants and provide suitable migration habitat for wildlife.
- Habitat fragmentation occurs primarily in the southern part of New Hampshire, while forestry and off-road vehicle impacts can occur throughout the state. Thus, the implementation of peatland buffers needs to occur statewide.
- The current rate of development in New Hampshire, as well as the growing use of off-road vehicles, suggests that the upland surrounding peatlands needs to be protected immediately to prevent further impacts.
- Buffer distances can be increased as necessary if data shows that peatland water chemistry or wildlife populations are still negatively affected by surrounding land uses.

(C) Conservation Performance Objective:
Establishing permanent buffers around peatlands will eliminate development, timber harvest, and off-road vehicle use, and will reduce increases in runoff from these activities within the buffer. Success will be measured by monitoring compliance with the buffer restrictions.

(D) Performance Monitoring
Projects occurring near the designated peatland buffer area will be monitored. Any project that involves land conversion (timber harvest, road or off-road trail building, construction) within a peatland buffer will be considered non-compliant with buffer restrictions.

(E) Ecological Response Objective
The desired ecological response to buffers around peatlands is no change in the water chemistry or vegetation composition of any peatland, and no decline in populations (averaged over time) of peatland-dependent wildlife or plant species.

(F) Response Monitoring
Populations of peatland-dependent plants and wildlife will be monitored, including ongoing monitoring of rare species. Water chemistry (pH and nutrient levels) will be periodically monitored (at intervals to be determined) in a random set of peatlands throughout the state. If water chemistry, vegetation, or wildlife population changes occur when land conversion activities occur immediately outside the buffer, increases in the buffer distance should be considered.

(G) Implementation

- An appropriate buffer distance will be determined, based on hydrology research and wildlife migration distances. Included in the buffer requirements will be the stipulation that off-road vehicle trails will be located at least 100 feet from any peatland to reduce visibility of the peatland and deter drivers from entering them.
- Delineate peatlands throughout the state (preferably all peatlands, but if not, then a significant number of important peatlands distributed throughout the state and across community classifications).
- Establish through regulation either a required buffer distance or strong incentives to include buffers in place (e.g., project restrictions or a high fee for non-compliance) during construction, road, and off-road vehicle

trail building, and other land conversion activities. Compliance with the buffer may be overseen by the New Hampshire Department of Environmental Services (NHDES) as part of the wetland review process.

(H) Feasibility
Enacting a regulation for a peatland buffer will require the agreement of various state agencies including NHDES, NHFG, and the New Hampshire Department of Resources and Economic Development (NHDRED) as well as legislators, which could slow the process. Buffering selected peatlands may be more feasible initially than buffering all peatlands. Once a peatland buffer is in place, enacting the buffer will be a regular part of the ongoing wetland review process of NHDES. If incentives are used rather than a strict buffer requirement, monitoring and enforcing buffers will require more time and effort.

4.1.2 Conservation Action: Delineate forested peatlands in northern New Hampshire and notify large landowners

Category: Education and Outreach

(A) List of Direct Threats Affected
Forestry activities in/near peatlands, Increased nutrient input

(B) Justification

- Mapping and notifying large landowners of the locations of forested peatlands on their properties will reduce winter harvesting in or near peatlands that are not properly mapped in existing GIS layers.
- Reducing harvesting in or near peatlands will protect the vegetation structure, reduce nutrient changes due to forestry activities, eliminate soil compaction, and increases woody debris around peatlands.
- Most large-scale timber harvesting occurs in northern New Hampshire; thus, delineation of peatlands in this region would be the most efficient way to target the highest number of unprotected peatlands affected by forestry practices. Prompt delineation of peatlands in northern New Hampshire will protect them before they are inadvertently damaged.
- Peatland delineations can be changed as beaver activities alter the landscape or if new peatlands are discovered. Landowners can be updated when any changes are made.

(C) Conservation Performance Objective
Delineating and notifying landowners about forested peatlands in northern New Hampshire will reduce the harvesting of timber in and near peatlands. Success will be measured by the number of delineated peatlands in northern New Hampshire that are harvested.

(D) Performance Monitoring
Opportunistic field checks and updated aerial photo analysis will allow for assessment of whether delineated peatlands have been cut. Peatland delineations will also be given to NHDES, who will process permit requests wetland impacts and can determine if harvest activities are likely to occur near a peatland.

(E) Ecological Response Objective
The ecological response objective is to eliminate changes to peatland structure, vegetation, and ecological processes from cutting.

(F) Response Monitoring
Opportunistic field checks of peatlands in northern New Hampshire will determine if vegetation and structure have changed.

(G) Implementation
Through color infrared aerial photo interpretation supplemented by field surveys, the predicted peatland map (element 1.6) will be refined in the Connecticut Lakes and Mahoosic-Rangeley Lakes ecoregion subsections, to create a detailed map of forested peatlands by community or system. Portions of the peatland map corresponding to different ownerships will be distributed to the landowners of commercial timberland. For this distribution process, a GIS layer of ownerships may need to be created if landowners cannot provide shapefiles of their holdings. In the event that GIS ownership data cannot be obtained, tax maps or other ownership maps will need to be used with care due to their lack of spatial accuracy. The entire map will be given to the NHDES Wetlands Bureau for use in the environmental review process.

(H) Feasibility

Finalizing the peatland map in northern New Hampshire through aerial photo analysis and field checking will require 1-2 people several months to complete, and landowner permission will be required for field visits. Obtaining accurate spatial data about ownerships will depend on the availability of this data, and if accurate digital data is not available, more time will be required to either digitize ownerships or select peatlands based on hardcopy maps.

4.2 Conservation Action Research

Determine an appropriate buffer distance for maintaining ecological functions of peatlands

Element 5: References

5.1 Literature

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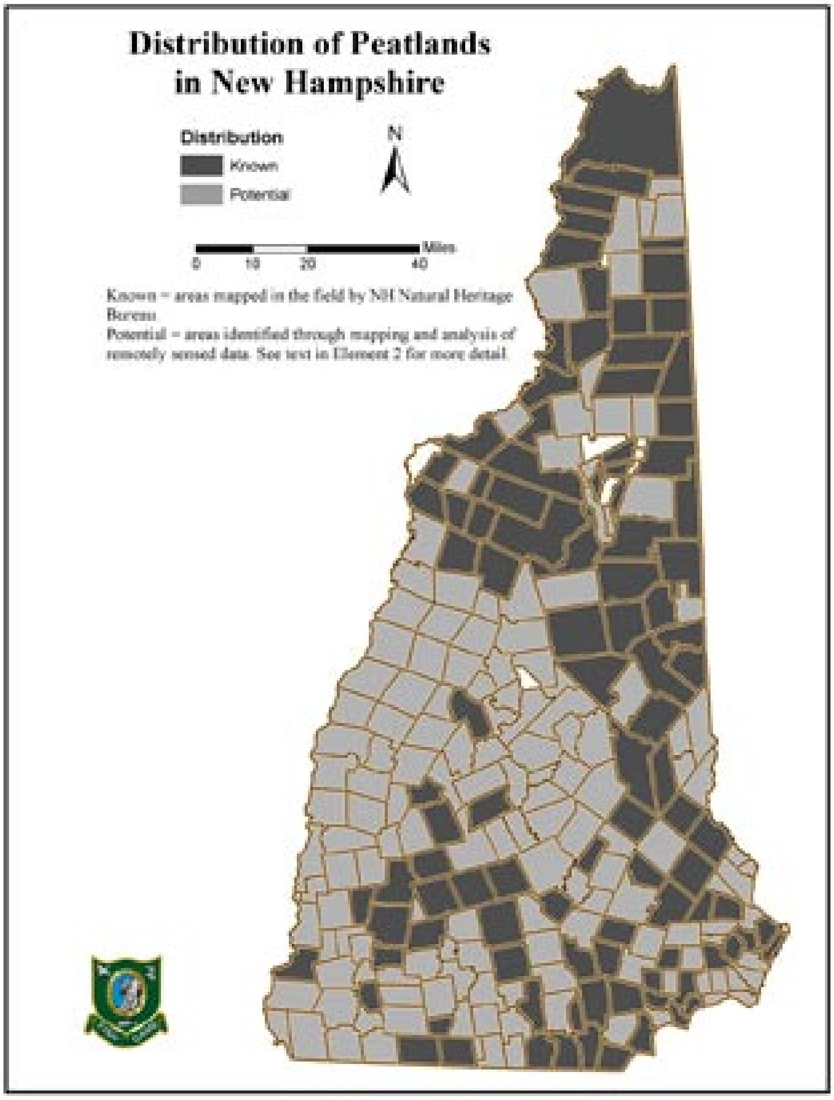
Distribution of Peatlands in New Hampshire
Distribution
Known
Potential
N
Miles
0
10
20
40
Known = areas mapped in the field by NH Natural Heritage Bureau
Potential = areas identified through mapping and analysis of remotely sensed data. See text in Element 2 for more detail.